

Optical tracking system and method

The present invention relates to an optical tracking system for determining the position and/or orientation of an object provided with at least one marker, having at least two image recording devices for capturing the image of said at least one marker and at least one computing device for evaluating the images captured by the image recording devices for computing the position and/or orientation of the object. Further, the invention relates to a corresponding tracking method, a computer program for implementing said method on a computer and also a computer program product having this program.

A tracking system and method of this kind for determining the position and orientation of a recording camera is known from DE-19806646 C1. For example, in order to be able to integrate a person filmed, precisely and true to position into a virtually created background, the respective position and orientation of the recording camera must be known. There, a tracking system having at least two light sources to be fitted to the camera, at least two viewer cameras for capturing images of said light sources and a computing device for evaluating these images is recommended. With an optimum number of light sources and viewer cameras, the position (three-dimensional location) and also the orientation (roll, tilt and pan angle) of the camera can be determined with sufficient accuracy. Advantageously, the light sources here are in the infrared range, so that these can be decoupled from the other light sources present in a studio. Commercially available CCD cameras are recommended as viewer cameras. The computation of position

and orientation of the recording camera occurs in a data processing system by means of trigonometric calculations.

A tracking system, in which infrared flashes released by light emitting diodes in defined time slots are received time-resolved by a synchronized camera, is known from WO99/52094.

Further, in WO99/30182 a tracking system is defined, in which said at least three markers of an object arranged in a predefined geometric relation to one another are, for example, captured by means of rays reflected from these markers, and the position and orientation of the object can then be calculated by comparison with stored marker arrangements.

The use of active (energy emitting) and passive (energy reflecting) targets to track an object provided with such targets is known from WO99/17133.

In the present invention, any object provided with at least one marker is monitored simultaneously by at least two tracking cameras or image recording devices, the spatial position and orientation of which are known, so that from the images delivered by these cameras the location of the marker and thereby that of the object in space can be determined with help of trigonometric methods. For this, visual rays originating from the location of each tracking camera are constructed for each marker, the point of intersection of the rays in space defining the three-dimensional location of the marker. By using a plurality of markers per object, besides the three-dimensional position, the orientation of the object in space, i.e. a "6-D position" can also be calculated. The orientation of an object is determined by the relative rotation of the object in space and the rotation around itself.

In the known and above described tracking systems, mostly the entire image area recorded by an image recording device (tracking camera) is read-out, digitized and scanned for markers. The positions of the markers found are subsequently calculated in two-dimensions (in the image coordinates) exactly. This data is forwarded to a host computer or a central computing process, where the data recorded by a plurality of image recorders at a time are collected. Further calculations, from which the position and/or orientation of the objects to be tracked is obtained, are based on this.

This separation of the individual operation steps has many disadvantages. Thus, for example, the readout of the image recording device in image areas where no markers exist, occurs in the same way as in the actually relevant image areas in which markers are present. The readout of the image recording device is however one of the main time constraints for precision tracking systems of this type, since the pixel information is fed sequentially into an A/D converter, and since on the other hand, in general, an increase in the readout frequency has a negative effect on the achievable accuracy.

Hence, it is the object of the present invention, to avoid the above disadvantages of time and memory intensive tracking systems and to achieve considerable gains in time with unreduced or increased tracking accuracy. Particularly by using reflecting markers, an increased accuracy should be achieved in the determination of the marker position in comparison to the known systems.

This object is accomplished by the features of an optical tracking system according to claim 1 and also by a